PROBLEM SET 1 - SOLUTIONS
14.02 Introductory Macroeconomics
February 16, 2005

I. Answer each as True, False, or Uncertain, providing a few sentences of explanation for your choice.

1. If taxes and government spending were both proportional (to income), then the government budget would improve during a recession.

Uncertain. During a recession, both revenues (from taxes) and expenses would drop, so the impact on the budget would depend on which one drops more.

2. A decrease in the inflation rate is unambiguously better for an economy since it reduces the erosion of real incomes in that economy.

False. As the Phillips curve indicates, there is a tradeoff between inflation and unemployment. It may well happen that the decrease in inflation is achieved at the cost of higher unemployment, which would not be better for the economy.

3. The performance of a country's economy is often tied to the performance of its stock market.

True. The episodes in Japan in the 1980s and in the US in the 1920s and then again in 2000, are ample evidence of the truth of this statement (see the revised version of Chapter 1, posted on the course website for descriptions of these episodes).

4. If the unemployment rate in a country drops, while the number of people of working age remains the same, then this must mean an increase in the number of people employed in that country.

Uncertain. It is possible for the unemployment rate to drop even without an increase in the number of people employed, for instance, through decreases in the participation rate which reduce the number unemployed proportionately more than the strength of the labor force.

5. Between 2003 and 2004, inflation as measured by the consumer price index increased due to a substantial increase in the price at which the government bought defense equipment for the war in Iraq.

False. Defense goods do not enter into the calculation of the consumer price index.

6. The rich spend more than the poor since they have more income to spend, therefore a tax cut designed to revive the economy from a recession should be targeted towards the rich.

False. Even though the rich spend more in absolute terms, they may have a lower marginal propensity to consume, i.e., they may consume a lower fraction of the extra dollar made available to them through the tax increase. If this were the case, then the tax cut should be targeted at the poor, since the multiplier for the poor would be larger.

II. Short questions

1. Consider an economy with three companies A, B, C. Company A produces cardboard, which is used by Company B to produce boards and cards, which is used by Company C to produce board games. Company A's revenues (from sales to Company B) amount to \$100, and its expenses on labor amount to \$30. Company B's revenues amount to \$ 250, and its expenses on labor amount to \$ 80. Company C's revenues amount to \$ 400, and its expenses on labor amount to \$ 90.

a. Show three different ways to compute this economy's GDP

GDP = Value of final goods produced = Revenues of Company C = \$ 400

GDP = Value added = 100 + (250 - 100) + (400 - 250) = \$400

GDP = Sum of incomes = Incomes from labor + Incomes from profits

= (30 + 80 + 90) + [(100 - 30) + (250 - 100 - 80) + (400 - 250 - 90) = \$ 400

b. Now introduce a government into this economy and also a fourth company, call it D, which produces exclusively for the government. The government buys goods from D, and pays for them by taxing the profits of Companies A, B and C at the rate of 25%. The government also chooses to run a budget deficit equal to 10% of GDP. Compute this new economy's GDP and company D's revenues (Assume that company D produces at zero cost).

First note that combined profits of companies A, B and C are \$ 200, so that the government is able to raise \$ 50 worth of tax revenues. Suppose Company D's sales are \$ x. Then GDP in this new economy is \$ (400 + x), which implies that the budget deficit is \$ 0.1.(400 + x), but this must be equal to the amount by which the government's payment to Company D falls short of the value of goods it buys from Company D, so 0.1.(400 + x) = x - 50, which gives x = \$ 100, so that GDP for this new economy is \$ 500.

2. Consider an economy which only makes cars. In 1991, the economy produced 10 cars at \$10,000 each. In 1992, it produced 12 cars at \$12,000 each, and in 1993, it produced 13 cars at \$13,000 each. Assume that real GDP is always calculated at 1992 prices.

a. Compute the rate of growth of real GDP from 1991 to 1992 and from 1992 and 1993

Real GDP for 1991 = \$ 12000 x 10 = \$ 120,000

Real GDP for 1992 = Nominal GDP for 1992 = \$ 12000 x 12 = \$ 144,000

Real GDP for 1993 = \$ 12000 x 13 = \$ 156,000

So growth rate of real GDP from 1991 to 1992 was (144 - 120)/120 = 20%

growth rate of real GDP from 1992 to 1993 was (156 - 144)/144 = 8.33%

b. Compute the rate of inflation from 1991 to 1992 and from 1992 to 1993

GDP deflator for 1991 = (Nominal GDP in 1991)/(Real GDP in 1991 measured at 1992 prices)

= 100/120 = 0.833

GDP deflator for 1992 = 1 (by definition)

GDP deflator for 1993 = (Nominal GDP in 1993)/(Real GDP in 1993 measured at 1992 prices)

= 169/156 = 1.0833

Therefore, inflation between 1991 and 1992 = (1 - 0.833)/0.833 = 20% approx.

inflation between 1992 and 1993 = 1.0833 - 1 = 8.33%

3. Consider an economy whose GDP of \$100 can be decomposed as follows : Private consumption = \$40, Government consumption = \$30, Private investment = \$30

a. Show that in this economy, savings = investment

Savings = Y - C - G = 100 - 40 - 30 = 30 = Investment

b. Now assume that the government of this economy embarks on a war effort, for which it requires military equipment, but such equipment is not produced at home, and must be imported from abroad. Suppose the amount of imports is \$ 20, all of which is consumed by the government, and that the government spends an additional \$ 20 to pay its soldiers. What is the economy's GDP now? Show the decomposition. Is savings=investment?

GDP = Y = C + I + G - M = 40 + 30 + (30 + 20 + 20) - 20 = 120

Savings = Y - C - G = 120 - 40 - (30 + 20 + 20) = 10, which is not equal to Investment which remains at \$ 30. What accounts for the difference? It is imports. In a closed economy, savings must be equal to investment, since it follows as an identity from the definition of equilibrium in the goods market. But in an open economy, savings and investment need not be equal, and in the general case, S - I = X - M

III. Long question

Suppose an economy is described as follows :

The consumption function is : $C = c_0 + c_1 Y$

The investment function is : $I = \overline{I}$ (a constant)

Government spending is : $G = \overline{G}$ (a constant)

Assume that the government is running a deficit equal to $\overline{G}$

1. Write the equilibrium condition for the goods market? What is the equilibrium output?

The equilibrium condition is : $Y = c_0 + c_1 Y + \overline{I} + \overline{G}$

Upon solving for Y, we get equilibrium output $Y^* = \frac{1}{1-c_1}(c_0 + \overline{I} + \overline{G})$

2. Find an expression for the goods market multiplier.

The multiplier is $\frac{1}{1-c_1}$

Assume for parts 3 and 4 that the government pays for its expenses by raising taxes, which are a constant fraction t of income.

3. Redo 1. and 2. Provide some intuition for why the multiplier is different.

Now the goods market equilibrium condition is

$Y = c_0 + c_1(Y - T) + \overline{I} + \overline{G} = c_0 + c_1(Y - tY) + \overline{I} + \overline{G}$

so the equilibrium output is $Y^* = \frac{1}{1-c_1(1-t)}(c_0 + \overline{I} + \overline{G})$

The multiplier is different since t cents out of every extra dollar of income "leaks" out to the government. This leakage shows up as a lower multiplier $\frac{1}{1-c_1(1-t)}$.

4. Assume that the economy begins trading with the rest of the world, and that imports are a constant fraction m of income (assume no exports). Find

an expression for the multiplier. Is it greater or lesser than the closed economy multiplier (the one you calculated in part 2.)? Explain the difference.

Now the goods market equilibrium condition is :

$Y = c_0 + c_1(Y - T) + \overline{I} + \overline{G} - M = c_0 + c_1(Y - tY) + \overline{I} + \overline{G} - mY$

so the equilibrium output is $Y^* = \frac{1}{1-c_1(1-t)+m}(c_0 + \overline{I} + \overline{G})$

The multiplier is $\frac{1}{1-c_1(1-t)+m} < \frac{1}{1-c_1(1-t)}$, since now there is an additional source of leakage, namely imports.

5. Return to the original setup of a closed economy. Assume that taxes are lump sum, i.e., not proportional (denote as T). Also assume that the government starts with a balanced budget. Then it increases spending, but also taxes, so that the budget remains balanced. Compute the impact of this spending increase on equilibrium output, i.e., derive an expression for $\partial Y^*/\partial G$ (or equivalently, $\Delta Y^*/\Delta G$) where Y^* is the equilibrium output. What is the multiplier? Why is the multiplier what it is?

The equilibrium condition in the goods market is

$Y = c_0 + c_1(Y - T) + \overline{I} + G$ (note that G is no longer denoted as a constant)

so that

$Y^* = \frac{1}{1-c_1}(c_0 - c_1 T + \overline{I} + G)$

which implies

$\Delta Y^* = \frac{1}{1-c_1}(-c_1 \Delta T + \Delta G)$ (where Δ denotes change, and taxes must change as well)

but $\Delta T = \Delta G$ for the budget to be balanced, so

$\Delta Y^* = \frac{1}{1-c_1}(1 - c_1)\Delta G = \Delta G$

So, under a balanced budget with lumpsum taxes, equilibrium output rises by the same amount as government spending (instead of a multiple), and the multiplier is 1. The reason that the multiplier is 1 (i.e., it is not really a multiplier any more) is that the multiplicative potential of government spending is exactly neutralized by the leakage due to the necessity to increases taxes to keep the budget balanced.